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Short Communication

A Comparative Study on the Chemical Composition of Fermented Oil Palm Fronds (OPF) by Using Probiotics with Fresh Unfermented OPF

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ABSTRACT

A study was conducted to compare the chemical composition of fermented oil palm fronds (OPF) by using a commercial probiotic with that of the fresh, unfermented OPF. Fresh, chopped OPF were sampled and dried in the laboratory and kept aside in a sealed bottle. The remaining OPF were spread out on the floor and sprayed with a dosage of 100 mL probiotics each; named BIOBAC 1, BIOBAC 2 and BIOBAC 3, for each one ton batch of chopped OPF. Prior to experiment, each probiotic was thoroughly mixed in a plastic container and poured into a sprayer. They were thoroughly sprayed onto OPF, mixed manually by using a shovel, and kept aside as a fermented mound of 1 meter height in a concrete-floored housing for 21 days. For the first five days, it was made sure that the heap was always moist to enable the BIOBAC 2 (fungus) to germinate to a certain extent. It was then left as they were to ferment and dry for 21 days. Samples were then taken at different spots of the heap and sent to the laboratory to be dried in the oven. These dried fermented OPF silages and the previously prepared dried samples of the fresh OPF were then taken for proximate analysis in the laboratory. The probiotics-treated silage was found to have a highly significant difference ($p < 0.01$) in dry matter, ash, calcium and NFE (soluble carbohydrates) when compared to the fresh unfermented OPF. Whilst crude protein, crude fiber and ether extract were also significantly higher ($p < 0.05$) when compared to the unfermented fresh OPF. There was no significant difference in phosphorus, TDN and ME (metabolic energy) values ($p > 0.05$) in the fermented silage when compared to the fresh, untreated OPF. It was thus concluded that probiotics-fermented silage could be one of the upcoming methods of treating waste material such as OPF to conserve feeds for animals and to improve their feeding values.

Keywords: Oil palm fronds, probiotics, silage, chemical composition

ABSTRAK

Satu kajian telah dijalankan untuk membanding komposisi kimia di antara pelepah kelapa sawit (OPF) yang difermentasi dengan menggunakan probiotik komersial, dengan OPF segar tanpa difermentasi. OPF segar dicincang secara mekanikal, disampel untuk dikeringkan di makmal dan disimpan di dalam botol kedap udara. OPF selebihnya, sebanyak 1 tan metrik telah ditebarkan di atas lantai dan disembur dengan 100 mL dos probiotik bagi setiap satu daripada tiga jenis probiotik; iaitu BIOBAC 1, BIOBAC 2 dan BIOBAC 3, bagi setiap kelompok satu tan OPF cincang. Sebelum eksperimen, probiotik tersebut dibancuh di dalam tong plastik dan dituangkan ke dalam tong penyembur. Ianya kemudiannya disembur rata pada OPF dan digaul secara manual menggunakan penyodok sehingga kesemua OPF terkena bancuhan probiotik. Setelah siap digaul, campuran ini dikumpulkan menjadi suatu timbunan seperti bukit setinggi 1 meter di dalam bangsal berkonkrit, dan dibiarkan selama 21 hari. Bagi lima hari pertama, ditentukan supaya bahan timbunan sentiasa lembab supaya bahan di dalam BIOBAC 2 (kulat) dapat bercambah sedikit. Ia kemudiannya dibiarkan selama 21 hari sehingga selesai proses fermentasi dan bahan menjadi kering. Sampel diambil secara rawak dari setiap sudut timbunan dan dibawa ke makmal untuk dikeringkan di dalam ketuhar. Bahan OPF yang difermentasi tersebut dan juga bahan sampel OPF segar yang tersimpan pada mulanya, diambil dan dibuat analisis proksimat di dalam makmal. Silaj yang difermentasi dengan probiotik ini didapati mempunyai perbezaan yang amat ketara dan tinggi ($P<0.01$) bagi bahan kering, abu, kalsium dan NFE (karbohidrat mudah hadam) dibandingkan dengan OPF segar yang tidak difermentasi. Disamping itu protein kasar, serat kasar dan ekstrak eter juga menunjukkan perbezaan besar yang bererti ($P<0.05$), dibandingkan dengan OPF segar yang tidak di fermentasi. Didapati tiada perbezaan ketara ($P>0.05$) bagi fosforus, TDN dan ME (tenaga metabolik), di dalam silaj yang difermentasi dibandingkan dengan OPF segar. Dengan demikian, diputuskan silaj yang difermentasi dengan menggunakan probiotik adalah satu kaedah penyediaan silaj yang berpotensi bagi mengawet bahan sisa seperti OPF untuk puliharaan makanan ternakan dan juga menambahbaik mutu nutrisinya.

Kata kunci: Pelepah kelapa sawit, probiotik, silaj, analisis kimia

INTRODUCTION

A lot of effort has been put into producing more meat-producing and milk-producing animals in Malaysia, but it is limited by the shortage of quality feeds. Emphasis has now been focused on using the by-products of oil palm, especially oil palm fronds (OPF). In the year 2000, there were over 3.3 million hectares of oil palm plantation in Malaysia, producing some 26 million metric tonnes of OPF (MPOB, 2004). Many studies have been undertaken to preserve this OPF in the form of silage, made mainly by the anaerobic fermentation method using blue plastic drums. This ensiling activity has been pursued in Malaysia since the 1960s (Chin and Idris, 1999). The main concern with the ensilaging technique of these products is the low dry matter and water soluble carbohydrate (WSC) contents. Suitable additives are being recommended to improve fermentation and nutritive values of conventional as well as round bale silages (Sharp *et al.*, 1994; Cowan, 1999).

Inclusions of acid, alkali and many others as chemical substances in the silage process can help in increasing the nutritive values of the by-product. Biological or biotechnological methods can also be used to improve nutritive value of by-products with the use of special techniques such as enzyme use (cellulose), mushroom inclusion (solid fermentation) and selected microbes (probiotics) (Wan Zahari, MARDI, Serdang, personal communication). Many researchers have reported on the nutrient contents of OPF. OPF is a good source of fiber but is low in protein. This will be a disadvantage to animals when given fresh to them due to the low digestibility of the fiber in OPF. This reduces volatile fatty acid (VFA) availability, which is the end product of fiber digestion, in relation to the overall efficiency of energy (Chen and Shamsuddin, 1991; Abu Hassan *et al.*, 1995; Dahlan, 2000). Some improvement in terms of nutritive value is needed to increase the degradability levels further. Proper ensiling process development is important in order to upgrade the frond silage quality without much nutrient deterioration. This study aims to determine if the ensiling method using probiotics would improve the protein content and digestibility in the form of higher energy content in OPF.

MATERIALS AND METHODS

Materials and implements needed and used in this study were: one tonne chopped OPF, probiotics, made up of BIOBAC 1 (bacteria), BIOBAC 2 (fungus) and BIOBAC 3 (enzyme), and an unused haversack sprayer, shovels, water and a concrete-floored housing without walls.

The BIOBAC 1, 2 and 3 were measured at 100 mL each for the one-tonne material and diluted into a quantity of water in a big container, enough to cover the whole one-tonne OPF and filled into the haversack sprayer. They were sprayed onto the OPF while another person would scoop up the bottom part of the OPF

to ensure that the probiotics mixture was mixed well with the OPF. Water was added to the mixture using the sprayer, again ensuring that it was mixed well, until the material felt wet (approximately 60% water). The entire ensiling material was then collected to one side of the housing, shaped and formed into a mound of about one meter in height. This was left to stand for 21 days to ferment and dry. During the first five days it was checked to make sure that the mixture was moist, to allow for the fungus to grow to a certain extent. This was done by taking a watering can filled with plain water and spraying some water over the top of the mound. Otherwise, it was just left to ferment and dry. When completed, it would be dry and ready to be used as a value-added forage substitute for ruminants.

After the 21 day period, the material was dried and samples were randomly taken and subjected to proximate analysis, as prescribed by AOAC (1990), together with the earlier dried fresh unfermented OPF.

The mean values of the nutrient contents of the OPF for the two treatments were obtained and were analyzed using *t*-test.

RESULTS AND DISCUSSION

The effect of probiotics usage on the fermented OPF is presented in Table 1. The mean values of DM, ash, Ca, and NFE of OPF silage treated with probiotics were higher than those of fresh, untreated OPF ($p < 0.01$), while CP, EE, and CF of OPF silage was slightly higher than those of the fresh, unfermented OPF ($p < 0.05$). On the other hand, the mean values of phosphorus in fresh OPF were not significantly different ($p > 0.05$) from those of the fermented OPF with *p*-value of 0.455, while the TDN and ME content were higher in OPF silage but not statistically significant ($p > 0.05$) with *p*-values of 0.183 and 0.189, respectively.

In this study, the effects of additional probiotics on OPF silages were analyzed. The results showed that mean values of DM, ash, Ca, and NFE of the OPF silage were highly significant at 0.01 levels, when compared to the fresh OPF, while the mean values of CP, EE, and CF of the OPF silage were significant at 0.05 levels. There was no significant difference for the mean of phosphorus content in fresh OPF when compared with those of fermented OPF with a *p*-value of 0.455, while the TDN and ME content were higher in OPF silage but not statistically different ($p > 0.05$) with *p*-values of 0.183 and 0.189, respectively. The proximate analysis showed that the quality of OPF silages with the addition of additives were beneficial. The purpose of using additives in silage is to improve silage preservation by ensuring that lactic acid bacteria dominate the fermentation phase in the ensiling process (Titterton *et al.*, 1999). Over the years, various feed additives such as acidifiers, enzymes, amino acids, probiotics, organic acids, as well as proprietary blends have emerged as potential alternatives (Global Industry Analysts, 2012) to increase nutritive value of animal feed and also animal performances. Numerous trials have been carried out to study the effect of

additives on silage quality including water, molasses and urea (Wan Zahari *et al.*, 2003).

Table 1. Differences in chemical composition between fresh OPF and OPF silage using probiotics.

Composition of feed	Fresh OPF	OPF silage using probiotics	*t*-value	*p*-value (2-tailed)
Dry matter (DM, %)	37.98 (± 1.37)[a]	55.16 (± 2.27)[b]	14.48	**
Crude protein (N x 6.25, %)	5.10 (± 1.54)[a]	9.52 (± 0.28)[b]	6.30	*
Ether extract (EE, %)	2.46 (± 0.39)[a]	1.84 (± 0.09)[b]	3.51	*
Crude fiber (CF, %)	42.38 (± 3.88)[a]	49.18 (± 1.98)[b]	3.48	*
Total ash (%)	5.02 (± 0.41)[a]	6.90 (± 0.17)[b]	9.47	**
Calcium (Ca, %)	0.21 (± 0.10)[a]	0.57 (± 0.04)[b]	7.69	**
Phosphorus (P, %)	0.12 (± 0.01)[a]	0.12 (± 0.01)[a]	0.78	0.45
N-free extract (%)	45.08 (± 2.38)[a]	32.76 (± 2.70)[b]	7.65	**
Total digestible nutrient (TDN, %)	41.74 (± 5.30)[a]	45.32 (± 1.47)[a]	1.46	0.18
Metabolizable energy (ME, MJ/kg)	5.98 (± 0.87)[a]	6.57 (± 0.24)[a]	1.44	0.19

Note: a, b in the same row showed non-significance at ($p > 0.05$);
* and ** denote statistical significance at levels of 0.05 and 0.01, respectively.

From the results obtained, there were highly significant differences (at 0.01 level of significance), in dry matter, ash, Ca, and NFE when the OPF was treated with probiotics. This shows that the addition of probiotics did improve the DM content. The DM recovery was higher due to additives being added compared to fresh OPF. Once the silage gained stability there was no more fermentation and at very low pH the microbes became part of the medium and reduction in DM was prohibited. In fact, homolactic acid fermentation which produces only lactic acid would be the desired fermentation because of the high energy and DM recoveries. In undesirable fermentation, large amounts of carbon dioxide (CO_2) are produced. Because CO_2 is a gas, the carbon (or dry matter) is lost to the environment. That is why these fermentations had low DM recoveries (Kung, 2007). Some studies reported that bacterial inoculants are most successful at DM intervals between 20-35% DM (Pahlow & Honig, 1993).

Ash gives an indication of the mineral content of silage. Normally ash concentrations of less than 10% DM are found provided that there was no soil contamination in the ensiling process. Ash content in silage OPF treated with probiotics showed a highly significant difference at 0.01 level. Previous studies (Garcia *et al.*, 1989; Mustafa *et al.*, 2000) reported that ash content increased to

some extent during ensiling at different fermentation periods. This increase may be attributed to an increase in DM during ensiling.

On the other hand, there were significant differences between fresh and treated OPF for the CP, EE and CF mean values, at 0.05 levels. This showed that inclusion of probiotics during fermentation can increase the protein, fat and fibre contents. Thus, addition of probiotics in silage can enhance the value of protein to the fresh OPF as was stated by the findings of Dahlan (2000) that showed OPF to be poor in protein content.

The underlying assumption in this study was that it will be profitable to use silage in the feeding system. Using probiotics in silage can improve feed values for the target species, reduce morbidity and mortality, and benefit consumers through improved product quality (Musa *et al.*, 2009).

CONCLUSION

The abundant availability of OPF throughout the year in Malaysia as one of the by-products from oil palm plantations will provide a practical and cost-effective feeding system for the ruminant industry. As OPF can be obtained throughout the year, the ensiling process can be applied to avoid wastage of these by-products and also to increase and improve its nutritive values for better animal performance. Silage additives can be used as one of the tools in order to improve silage quality. The study revealed that the nutritional value of OPF silage after being treated with probiotics increased especially its protein value. The results showed the probiotics silage had a significant difference in the protein value compared to the fresh OPF. Thus, we can conclude that probiotics can increase and improve nutritive values of fresh OPF in making silage.

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